U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—CIRCULAR NO. 34 (Revised).

A. C. TRUE, Director.

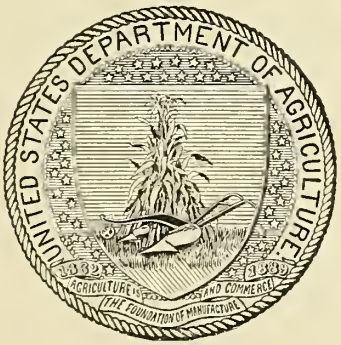
RULES AND APPARATUS

FOR

SEED TESTING.

ADOPTED BY THE STANDING COMMITTEE ON METHODS OF SEED TESTING OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

[Corrected November 7, 1906.]



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OFFICE OF EXPERIMENT STATIONS—Circular No. 34 (Revised).

A. C. True, Director.

Washington, D. C., *June 1, 1904.*

Sir: In response to a memorial signed by a majority of the directors of the agricultural experiment stations of the United States, the Association of American Agricultural Colleges and Experiment Stations, at the convention held in Washington in November, 1896, appointed "a committee of experts in seed testing to devise and adopt a standard form of seed-testing apparatus and method of procedure for use in all American stations." This committee, which consisted of E. H. Jenkins, the late G. H. Hicks, G. McCarthy, F. W. Card, and W. R. Lazenby, formulated rules for seed testing, which were published as Circular 34 of this Office.

In view of the improvements which have been made in apparatus and methods of seed testing since this circular was issued, the standing committee of the association, consisting of E. H. Jenkins, director of the Connecticut State Agricultural Experiment Station, chairman; F. W. Card, horticulturist, Rhode Island Agricultural Experiment Station; W. R. Lazenby, professor of horticulture, Ohio State University; E. Brown, in charge of the Seed Laboratory of the Bureau of Plant Industry of this Department, and A. B. Shamel of that Bureau, at the convention held in Washington in November, 1903, recommended and the association authorized, a revision of the rules, which should include especially a description of an improved and less expensive germinating chamber and other pieces of improved apparatus, more specific directions regarding sampling, and more definite information regarding seed bed, temperature, and duration of test for each of the common seeds. The revised rules as adopted by the committee, together with the accompanying blanks for reports and descriptions of the approved apparatus, are submitted, with the recommendation that they be published as Circular 34, revised, of this Office.

Respectfully,

A. C. True, *Director.*

Hon. James Wilson,
Secretary of Agriculture.

RULES AND APPARATUS FOR SEED TESTING.

[Adopted by the standing committee on methods of seed testing of the Association of American Agricultural Colleges and Experiment Stations.]

SAMPLING.

The first requisite in making a seed test is the careful taking of the sample. This should be done in such a way that the seed sent for testing will be a fair average of the larger bulk from which it is drawn.

Many complicated schemes have been devised to govern the taking of samples, any one of which, if carefully followed, will give good results.

The following general directions are suggested as being satisfactory:

BULK SEEDS.

When small quantities of not more than 5 bushels are to be sampled, the entire lot should be emptied on a floor or other flat surface and thoroughly mixed, and a small quantity of the seed taken from different parts of the pile to make up the sample to be sent for testing.

Fig. 1.—Seed sampler (long).

When seed in a bin is to be sampled, a grain sampler (fig. 1) should be used with which seed can be taken from the various parts of the bin, both top and bottom, and mixed thoroughly, and the sample for testing taken from this lot.

When seed in sacks is to be sampled, a small amount should be taken from the top, middle, and bottom of each (fig. 2), in the case of a few sacks, or from the middle of each, in the case of a large number of sacks. This seed should then be thoroughly mixed and the sample taken as before.

Fig. 2.—Seed sampler (small).

SEED CORN ON COB.

The ears of corn should first be piled in ricks so that each rick is exposed to view. When lots of from 25 to 500 bushels are to be sampled, one ear should be taken indiscriminately from each square foot or from each 5 square feet of rick surface, according to the amount to be sampled. When 500 bushels or more are to be sampled, one ear should be taken indiscriminately from each 10 square feet of rick surface. These ears should be shelled, and the shelled corn finally sampled the same as bulk seed.

WEIGHT OF SAMPLE.

All samples sent for test should weigh approximately as follows:

	Ounces.
Redtop, blue grass, timothy, and all smaller seeds	1
The smaller vegetable seeds, such as lettuce, onion, radish, and turnip	1
Clovers, alfalfa, and sorghums	2

	Ounces.
All the larger grass seeds, such as rye grass, brome grass, orchard grass, and millets	2
All the larger vegetable seeds, except corn, peas, and beans	2
Cereals, vetches, cowpeas, corn, peas, beans, and all large seeds not provided for	4

The amounts to be taken of seeds not enumerated should be the same as those required for seeds named which are of similar size.

SENDING SAMPLES.

Every sample sent to be tested should be inclosed in a strong, securely fastened package and be accompanied by a statement giving the following information:

Name under which seed was sold.....
Name of seller.....
Address of seller.....
Price paid.....
When grown.....
Where grown.....
Name of sender.....
Address of sender.....
Date.....

PURITY TESTS.

AMOUNT OF SEED USED.

All purity tests should be made by weight from smaller fair average lots taken from the samples submitted. The minimum quantities to be used are given below, and should be taken in such a manner as to make them thoroughly representative of the samples submitted. (See description of mixer and sampler, p. 11.)

One gram: *Agrostis* spp., *Poa* spp., yellow oat grass, tobacco.

Two grams: Bermuda grass, velvet grass, timothy, meadow foxtail, crested dog's tail, orchard grass, sweet vernal grass, alsike clover, white clover, Umbelliferæ, and all the fescues except meadow fescue.

Three grams: All grass seeds not enumerated above.

Five grams: *Melilotus* spp., *Medicago* spp., millet, lettuce, and all clovers except white and alsike.

Ten grams: Cruciferæ, flax, and *Lespedeza* spp.

Thirty grams: Buckwheat, *Vicia* spp., *Lathyrus* spp., beet "balls," esparcet, lentils, sunflower, teosinte, serradella, vine seeds, and all cereals except corn.

Fifty grams: Peas, beans, white lupine, cowpeas, cotton, and corn.

Amounts to be taken of seeds not enumerated should be the same as those required for seeds named which are of similar size.

In case the sample is suspected to contain any seed of a pest, such as dodder, Canada thistle, wild mustard, plantain, etc., the entire sample, or, where it contains more than 50 grams, at least 50 grams should be examined for that impurity.

METHOD OF TESTING.

When the smaller average lot has been weighed, it should be separated, either by hand or mechanically and by hand, into three parts:

Pure seed.—Seed of the kind being examined.

Inert matter.—Broken seeds, dirt, stones, sticks, and chaff.

Foreign seed.—Seeds of all kinds except the one being examined.

After the separation has been made into these three component parts, the percentage by weight of each should be recorded on the record sheet. The foreign seeds should be separated and identified. When any one of the kinds of foreign seeds constitutes 1 per cent or more of the entire sample, the percentage by weight should be recorded; when the amount is less than 1 per cent, the number of seeds should be recorded.

ADULTERATED SAMPLES.

As seeds used as adulterants closely resemble the seed with which they are mixed, the making of purity tests of adulterated samples is usually slow and tedious.

The work of testing such samples may be greatly shortened and still be accurately done by using the following method: After the smaller average lot has been weighed out, separate the seed into three parts, (1) inert matter; (2) all foreign seed except adulterants; (3) pure seed and adulterants. From the mixture of pure seed and adulterants count out 1,000 seeds indiscriminately and separate the adulterants from the pure seed. The percentage of each can be determined by the proportional number or weight of each in the 1,000 seeds actually separated.

GERMINATION TESTS.

SEED USED, SOURCE AND QUANTITY.

In making germination tests the entire amount of pure seed obtained in making the purity test should be thoroughly mixed, and 100 seeds of peas, beans, corn, vine seeds, and those of a similar size; and 200 seeds of clover, timothy, cabbage, wheat, and others of similar size and smaller, should be taken indiscriminately for each of the duplicate tests.

DUPLICATE TESTS AND ALLOWABLE VARIATION.

Germination tests should be made in duplicate simultaneously and under identical conditions, and the average percentage of germination should be recorded on the record sheet. If the duplicate tests vary more than 10 per cent a retest should be made and a supplementary test in sand is also recommended.

SUBSTRATUM OR SEED BED.

Chamber tests.—Two kinds of substrata should be used for chamber tests.

(1) Canton flannel of a medium weight, cut in strips 8 by 32 inches and folded twice lengthwise, should be used for peas, beans, corn, lupines, cotton, cowpeas, and other seeds of similar size. These cloths can be sterilized by boiling and used repeatedly.

(2) Blue blotting paper, 120 pounds to the ream, free from injurious chemicals, cut in strips 6 by 19 inches and folded twice lengthwise, should be used for all small seeds. Blotting paper should be used once only.

Sand tests.—The sand used in making supplementary tests should be free from organic matter, sifted to a uniform size of approximately 1 millimeter, and sterilized by heating.

PLACING SEEDS IN SUBSTRATA.

All seeds, both in chamber tests and in sand tests, should be placed far enough apart to avoid contact during the process of germination.

Chamber tests.—Seeds of *Agrostis* spp., *Poa* spp., timothy, tobacco, and others of similar size should be placed on top of blotters. All the larger seeds should be placed between the folds of blotting paper or cloth.

Sand tests.—Seeds of *Agrostis* spp., *Poa* spp., timothy, tobacco, and others of similar size should be sown on the surface and the lightest possible covering of sand given them. All the larger seeds should be planted at depths about equal to twice their greatest diameter.

MOISTURE.

The blotting paper, cloth, or sand used as a substratum should be kept well moistened, but not saturated, during the time of germination test. Only potable water of a temperature approximating that of the substratum should be used. In sand tests the flats should be sufficiently shaded to prevent rapid evaporation from the surface and the consequent drying out of the top layer.

ALTERNATING TEMPERATURE.

Chamber tests.—When an alternating temperature is used the seeds should be kept at the lower temperature for eighteen hours and at the higher temperature for six hours each day.

Sand tests.—All sand tests should be made in a room or greenhouse where the temperature is as nearly as possible 68° F. (20° C.) for eighteen hours and 86° F. (30° C.) for six hours each day.

COUNTING SPROUTS.

Chamber tests.—The sprouted seeds should be removed from the blotters or cloths and counted every second day in the case of quickly germinating seeds and every third day in the case of slowly germinating seeds.

Sand tests.—Only those sprouts should be counted which appear above the surface of the sand. The sprouts should not be removed at the time of making the preliminary report.

SUPPLEMENTARY TESTS.

Supplementary tests in sand are recommended in the case of all seeds which do not germinate well in the chamber tests. The results of the supplementary tests should be accepted when they show a higher percentage than the chamber tests.

HARD SEEDS.

At the close of chamber tests one-third of the leguminous seeds which remain hard should be counted as viable.

SUBSTRATA, TEMPERATURES, AND DURATION OF TESTS.

The following table, based on work done in the Seed Laboratory of the Bureau of Plant Industry of this Department, gives the substrata, optimum temperatures, and days on which both preliminary and final reports should be made on chamber tests of the common seeds. For sand tests two days longer should be allowed both for preliminary and final reports.

Conditions for germination tests of different seeds.

Kind of seed.	Substratum.[a]	Temperature.	Day for making germination report.	
			Preliminary.	Final.
FIELD CROPS.		°C.		
Barley	B	20	3	6
Beans	C	20–30	3	6
Beets[b]	B	20–30	5	8
Buckwheat	B	20–30	4	8
Corn	C	20–30	3	6
Cotton	C	20–30	4	8
Flax	B	20–30	3	6
Hemp	B	20–30	3	6
Oats	B	20	3	6
Peas	C	20–30	3	6
Rice	B	20–30	4	8
Rye	B	20	3	6
Tobacco	TB	20–30	6	14
Turnips	B	20	3	6
Wheat	B	20	3	6

[a] B—between blotting paper; TB—on top of blotting paper; C—between folds of cloth.
[b] Soak six hours in water at room temperature before testing for germination.

Conditions for germination tests of different seeds—Continued.

Kind of seed.	Substratum.	Temperature.	Day for making germination report.	
			Preliminary.	Final.
GRASSES, CLOVERS, AND FORAGE PLANTS.		° C.		
Alfalfa	B	20	3	6
Bermuda grass	TB	20–35	10	21
Blue grass	TB	20–30	14	28
Brome grass	B	20–30	5	10
Clover, alsike	B	20	3	6
Clover, crimson	B	20	2	4
Clover, mammoth red	B	20	3	6
Clover, common red	B	20	3	6
Clover, white	B	20	3	6
Cowpeas	C	20–30	4	8
Meadow fescue	B	20–30	5	10
Millet	B	20–30	3	6
Orchard grass	B	20–30	6	14
Rape	B	20	3	6
Redtop	TB	20–30	5	8
Rye grass	B	20–30	6	14
Sorghum	B	20–30	4	8
Soy beans	C	20–30	4	8
Teosinte	B	30	4	8
Timothy	TB	20–30	5	8
Turnips	B	20	3	6
Vetch	C	20–30	4	8
VEGETABLES.				
Asparagus	C	20–30	6	14
Beans	C	20–30	3	6
Beets[a]	B	20–30	5	8
Cabbages	B	20	3	6
Carrots	B	20–30	6	14
Cauliflower	B	20	3	6
Celery	TB	20–30	6	14
Cucumbers	B	20–30	3	6
Kale	B	20	3	6
Lettuce[b]	B	20	2	4
Muskmelons	B	20–30	3	6
Okra	C	20–30	4	8
Onions	B	20–30	4	8
Parsley	B	20–30	14	28
Parsnips	B	20–30	6	14
Peas	C	20–30	3	6
Peppers	B	20–30	4	8
Pumpkins	C	20–30	3	6
Radishes	B	20	2	4
Salsify	C	20–30	5	10
Spinach	B	20	5	10
Squashes	C	20–30	3	6
Sweet corn	C	20–30	3	6
Tomatoes	B	20–30	4	8
Turnips	B	20	3	6
Watermelons	B	20–30	4	8

[a] Soak six hours in water at room temperature before testing for germination.
[b] Soak two hours in water at room temperature before testing for germination.

KEEPING SAMPLES.

A sufficient amount of each sample should be kept in a dark, dry, cool place for six months for use if a retest is found necessary.

RECORD SHEETS.

A record sheet should be kept for each sample, on which should be recorded the serial test number; the sender's identification mark; the Latin and common names of the seed; the name and address of the sender; the year and place of growth; the weight of the smaller average lot used in making the purity test; the percentage by weight of pure seed; the percentage by weight and the character of the inert

matter; the percentage by weight of foreign seeds, with a memorandum of the number or percentage of each; the kind and temperature of the substratum; the number of seeds germinated at the time each count was made and the day of the test upon which each count was made; the average percentage of germination and the day of the test upon which the preliminary report was made; the number of leguminous seeds remaining hard at the close of the test, one-third of which should be counted as viable, and the total average percentage of germination and the duration of the test.

REPORTS.

All reports should show the date of receipt of the sample, the serial test number, the sender's identification mark, and the common name of the seed.

PURITY TEST REPORT.

This should show the percentage by weight of the pure seed, the percentage by weight and character of the inert matter, and the percentage by weight of foreign seeds. The quantity of each important foreign seed present should be shown and special attention should be called to the seeds of all noxious weeds.

PRELIMINARY GERMINATION REPORT.

This should show the number of days during which the test has been in progress and the average percentage of germination up to that time.

FINAL GERMINATION REPORT.

This should give the duration of the test, the average percentage of total germination, and the actual value of the sample—that is, the percentage of viable pure seed. The actual value of the sample is obtained by multiplying the percentage of pure seed by the percentage of total germination of the pure seed.

The forms shown on pages 22–24 are recommended.

APPARATUS AND MATERIAL.

The following apparatus is recommended for use in making purity and germination tests.

PURITY TESTS.

(1) A chemical balance, weighing up to 100 grams and sensitive to 1 milligram, with accurate metric weights.

(2) A seed mixer and sampler. (See description, p. 11.)

(3) A nest of small copper sieves. (See description, p. 14.)

(4) A vertical air-blast seed separator. (See description, p. 14.)
(5) A reading glass mounted on a stand. (See description, p. 17.)
(6) A hand lens, magnifying from 10 to 16 diameters.
(7) A standard dissecting microscope.
(8) Botanical forceps and dissecting instruments.
(9) An authentic collection of the seeds of the principal weeds and cultivated plants.

GERMINATION TESTS.

(1) Standard or Sempers germinating chambers, equipped with low-temperature thermostats and thermometers. (See description, p. 18.)
(2) Blue blotting paper and canton flannel.
(3) Sterilized sifted sand and shallow greenhouse flats.
(4) Forceps.

REFERENCE WORKS.

A collection of reference works should be at hand, treating of seed growing and seed testing, and of the morphology and physiology of seeds. In addition to the regular publications of the European seed-control stations, bulletins of the State agricultural experiment stations, publications of the United States Department of Agriculture, and the chapters on seeds in structural botanies, the following are recommended as being of special importance:

Burchard, Dr. O. Die Unkrautsamen. Berlin, 1900.
Detmer, W. Vergleichende Physiologie des Keimungsprocess der Samen. Jena, 1880.
Harz, C. D. Landwirthschaftliche Samenkunde. Berlin, 1885.
Lubbock, John. A contribution to our knowledge of seedlings. London, 1892.
Nobbe, Friedrich. Handbuch der Samenkunde. Berlin, 1876.
Settegast, Henry. Die landwirthschaftlichen Sämereien und der Samenbau. Liepzig, 1892.
Vandevelde, A. J. J. Die Kieming der Zaadplanten Morphologie en Physiologie. Ghent, 1896. (This is the most complete bibliography of seed literature published, containing over 2,100 references.)
Wollny, Ewald. Saat und Pflege der landwirthschaftlichen Kulturpflanzen. Berlin, 1885.

DESCRIPTIONS OF APPARATUS.

SEED MIXER AND SAMPLER.

It is difficult to mix a sample thoroughly before taking the smaller average lot for purity test when it contains both heavy and light material. The machine shown in figures 3 and 4 has been found satisfactory for this work. It consists, essentially, of a revolving funnel (*a*) emptying over a divide (*e*) into two spouts (*f*). The funnel is revolved by means of the crank, so the seed from all parts of the funnel fall first in one spout and then in the other. The stopper (*b*) is raised and

lowered by means of the thumbscrew (*d*) on the upper end of the rod (*c*). In operating, the bottom of the funnel is closed with the stopper, the seed is put in the funnel, the thumbscrew held with the left hand, and the crank turned with the right hand. The stopper is gradually

FIG. 3.—Seed mixer and sampler.

raised until a sufficient opening is made for the seed to run out. The thumbscrew is then released and the crank turned until all the seed has run through. The seed from one of the receptacles can be emptied back and divided as many times as is necessary, until the amount in one of the receptacles is approximately that of the smaller average sample wanted for the purity test.

SIEVES.

Purity testing can be greatly facilitated by properly sifting the weighed sample. This can be done without loss by means of a nest of sieves similar to those shown in figure 5. They are made of copper,

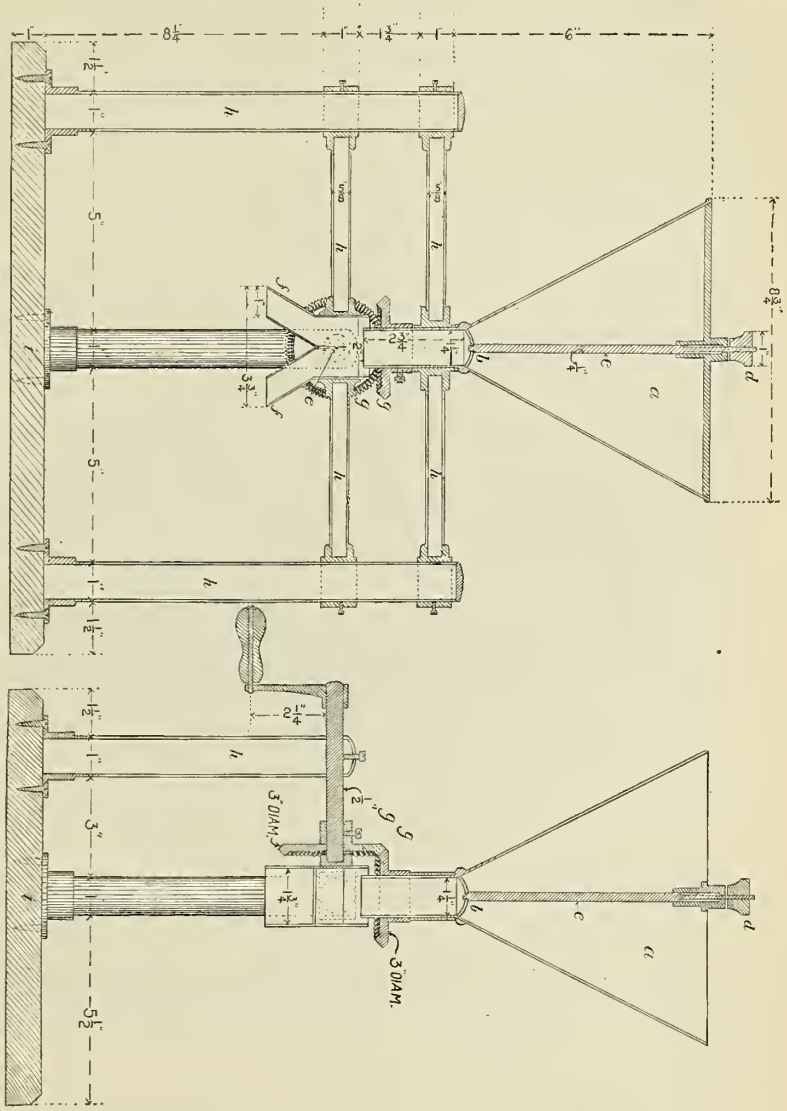

Fig. 4.—Drawing of seed mixer and sampler.

each about 2 inches high and about 4 inches in diameter, with copper bottoms having circular perforations ranging from one-half to 2 millimeters in diameter. The place where the screen joins the side must be soldered perfectly smooth to prevent the seed lodging. The set is

provided with a top and bottom. In using, the sieves are arranged with the coarsest one upon the top and the finest one on the bottom. The seed is put in the top sieve and the whole gently shaken in the hands.

VERTICAL AIR-BLAST SEED SEPARATOR.

The making of purity tests of chaffy samples of grass seeds, such as redtop and blue grass, is very slow work, even after careful sifting. A great amount of time is required in making the tests and the strain on the eyes of the operator is very severe when working continuously on small seeds. By means of the apparatus shown in figures 6 and 7 a very close separation can be made between chaff and pure seed. After a sample of chaffy seed has been blown—which operation does not take

FIG. 5.—Sieves.

more than one or two minutes—the purity test can be completed in from one-quarter to one-half the time that would be required if it were not blown. It is also very useful in separating seeds which are practically the same size and shape, but have a slight difference in specific gravity. It was designed to make separations with weighed samples which can not be made with sieves.

The essential parts of the machine are two glass tubes, shown in figure 7. The blowing tube (A) is tapered at the lower end with a slight flange (*a*) at the bottom. The upper end is drawn out slightly and turned over, making an angle of about 70°, the end (*b*) being opened, making it somewhat bell-shaped. The receiving cylinder is open at both ends, ground on the bottom (*d*), with a circular hole (*c*) in one side. In using

this machine a piece of bolting cloth is put over the lower end of the tube (A) and tied above the flange at the bottom. A weighed sample of seed is put in the top of the tube (A), the bottom is set into a funnel-shaped opening in the table, as shown in figure 6. The top of the tube is put through the hole in the side of the cylinder (B), which rests

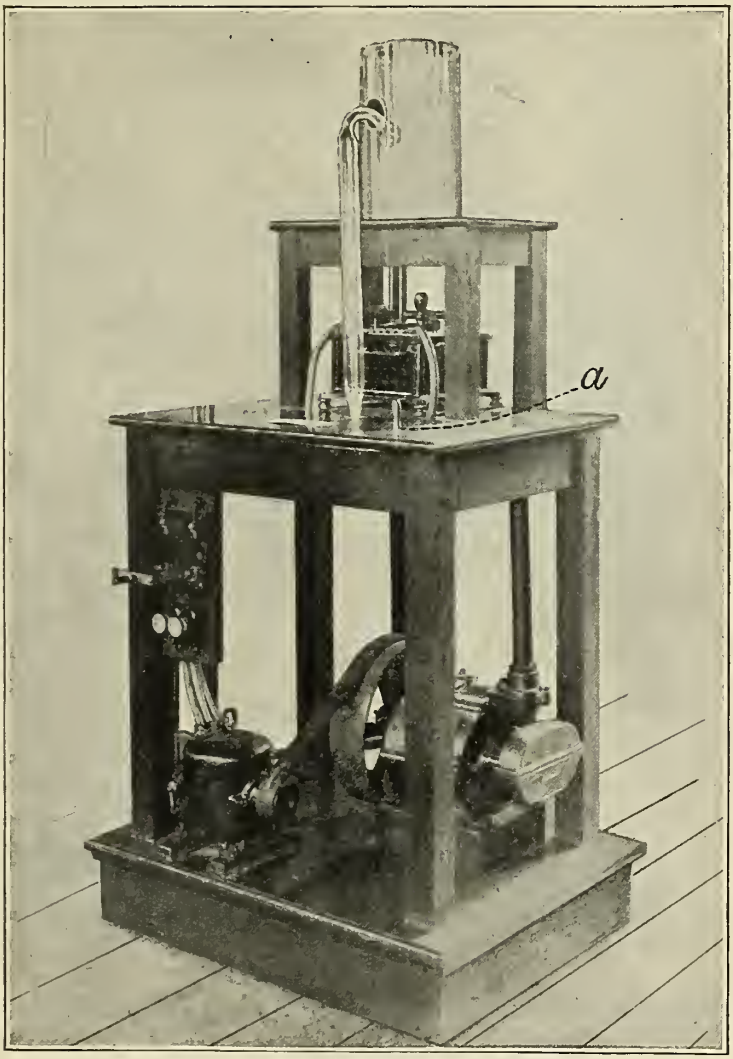

FIG. 6.—Vertical air-blast separator.

on a sheet of white paper. The blower is then set in motion and the air gradually turned into the blowing tube by means of the valve (*a*), shown in figure 6. The air gradually raises the seed in the blowing tube and the lightest part is carried over into the receiving cylinder and falls on the paper. The sample can be blown until only the heavy

seed is left in the blowing tube, or several separations can be made. It is usually better to divide the sample into three lots, the first containing most of the chaff and no seed, the last containing no chaff

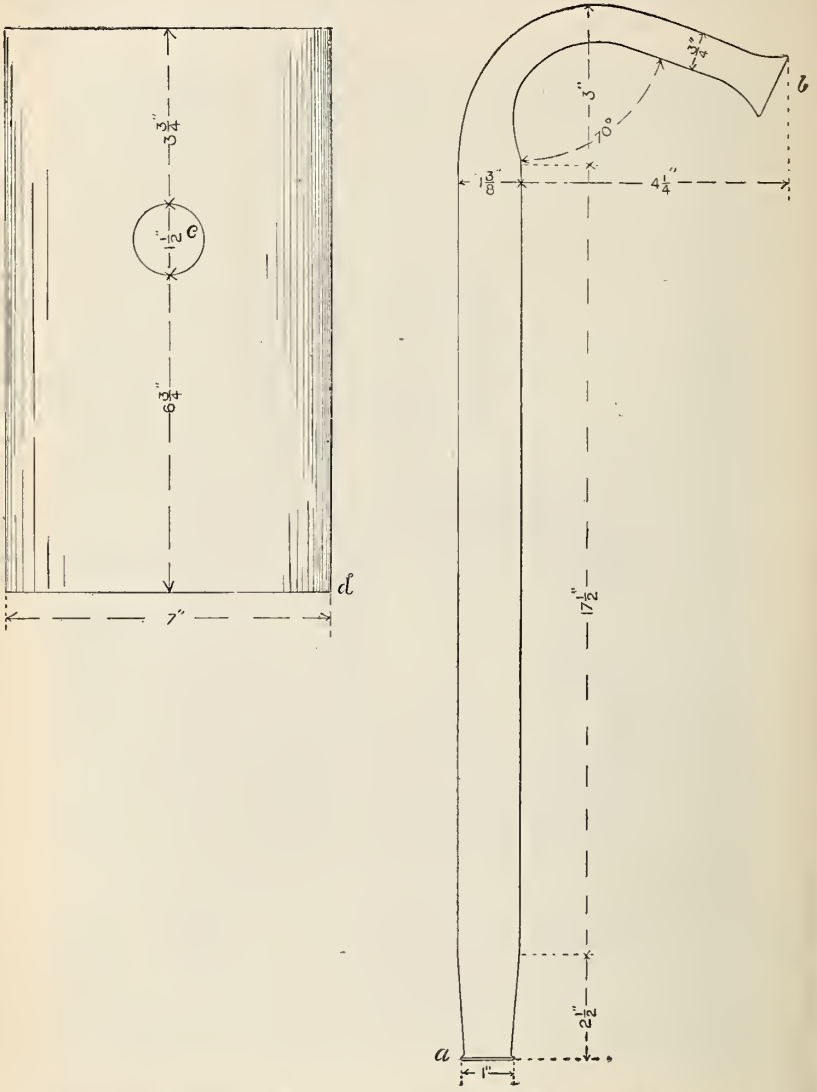

FIG. 7.—Drawings of vertical air-blast separator: *a*, flange at bottom of blowing tube; *b*, bell-shaped mouth of blowing tube; *c*, circular opening in side of receiving cylinder; *d*, ground lower edge of receiving cylinder.

and most of the seed, and the second lot, which can be made very small, containing both chaff and light seed. In this way, the first and third lots have to be gone over for foreign seeds only, and the small

second lot is all that needs actual separation by hand. Where the approximate purity of a sample within 1 or 2 per cent is required no hand work is needed, as the separation can be made sufficiently close with the machine. The blower required to operate this machine should be capable of furnishing a one-half inch stream of air under a pressure of about one-half pound per square inch.

READING GLASS.

In making purity tests of small seeds a low-power magnifying glass, giving a large field, is needed. Figure 8 shows a lens well adapted to

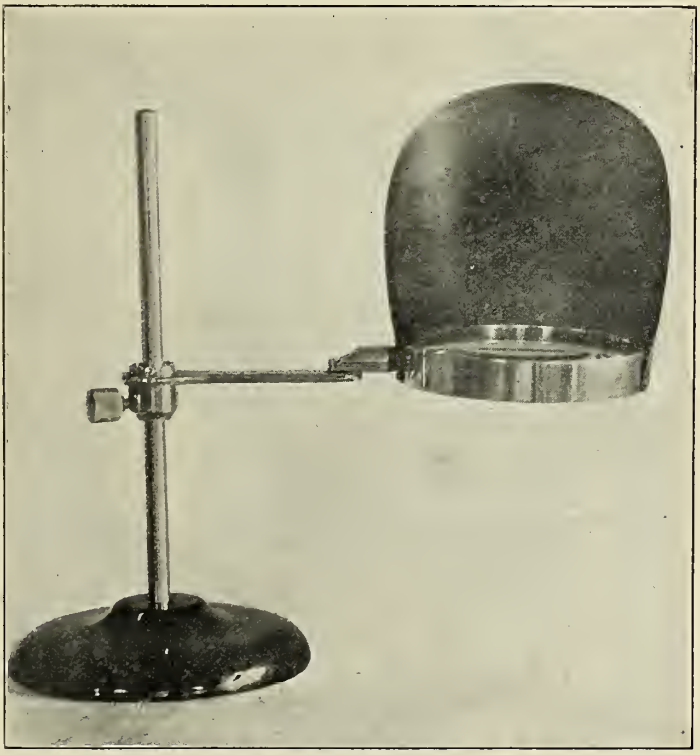

FIG. 8.—Reading glass and stand.

this work. It consists of a reading-glass lens 4 inches in diameter, with a focus of 9 inches. This can be turned in a horizontal plane and moved up and down by means of its attachment to the standard and the joint in the arm. A shade is put on one side, which shields the eyes from the reflections from the lens. This lens is used at a distance of 3 to 4 inches from the table, giving ample room to work underneath with forceps in making separations.

IMPROVED STANDARD GERMINATING CHAMBER.

This chamber is essentially the same as the one designed by the late Gilbert H. Hicks and described in Circular No. 34 of the Office of Experiment Stations. The principal changes that have been made

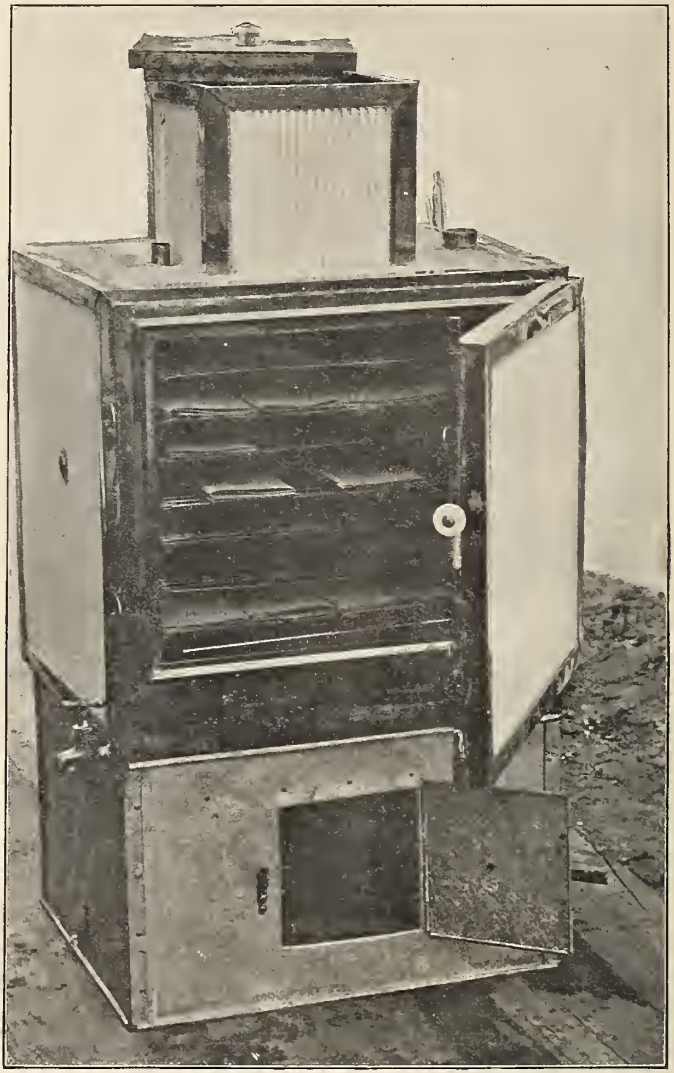

FIG. 9.—Improved standard germinating chamber.

(see fig. 9) are as follows: A solid door has been substituted for the glass one, it having been found that the light admitted through the glass door does not in any way affect germinations under ordinary conditions. Air-cell asbestos has been substituted for felt, the asbestos

making a satisfactory lagging and being much more durable than felt. An ice box has been added on top. This was found necessary in order to maintain the low temperatures required for certain seeds during warm weather. By means of a low-temperature thermostat this chamber can be regulated very accurately, and it is recommended for use when work is being done on methods of germination. Figure 10 shows working drawings of the chamber.

It is made of 20-ounce corrugated sheet copper, the 2-inch space (*c*)

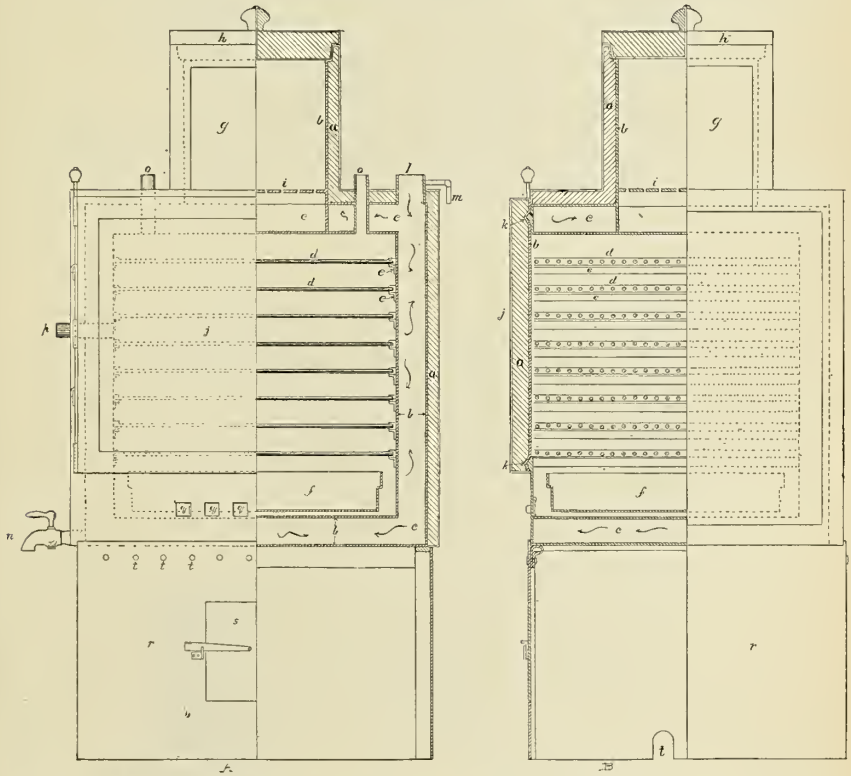

FIG. 10.—Drawings of improved standard germinating chamber: A, front view; B, side view; *a*, air-cell asbestos lagging, covering all sides except the bottom; *b*, copper walls of chamber; *c*, water jacket on all sides except the front; *d*, trays; *e*, ledges on sides of chamber supporting trays; *f*, water pan; *g*, ice box; *h*, cover to ice box; *i*, perforated bottom to ice box; *j*, door; *k*, tongue fitting into felt-lined groove; *l*, opening into water jacket; *m*, overflow pipe; *n*, drain for water jacket; *o*, opening into top of chamber; *p*, opening into side of chamber; *q*, openings into chamber under door closed by slide; *r*, galvanized iron base; *s*, door in base; *t*, ventilator in base.

between the double walls serving as a water jacket. Outside the water jacket is a 1-inch covering (*a*) of air-cell asbestos on all sides except the bottom. The ice box (*g*) is an extension of the water jacket and opens into the latter through the perforated bottom (*i*). It is fitted with a cover (*h*) which can be removed to put in ice or to fill the water jacket. The door (*j*) is made of 20-ounce plain sheet copper, covered with air-cell asbestos (*a*) the same as the sides of the chamber.

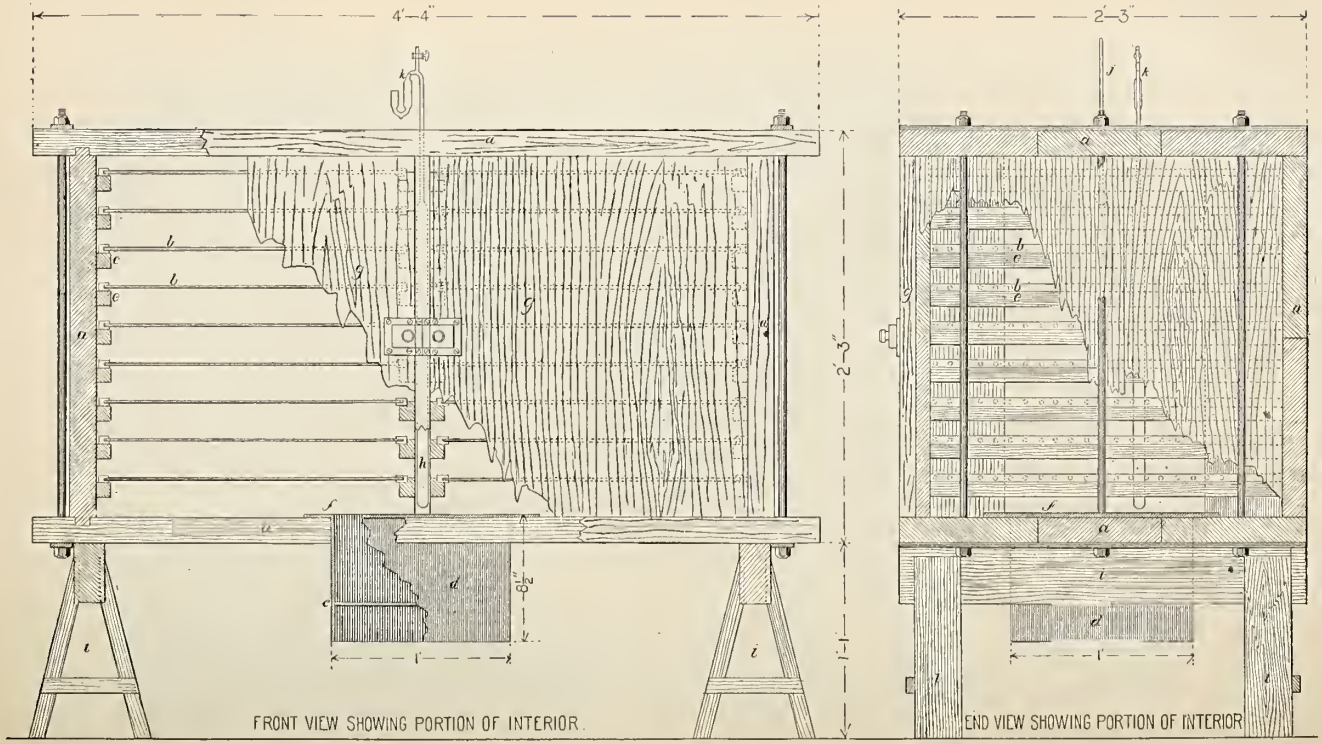

FIG. 11.—Drawings of Semper's germinating chamber: *a*, wooden walls of chamber; *b*, trays; *c*, ledges supporting trays; *d*, open copper water tank; *e*, bottom of water tank; *f*, flange on top of water tank; *g*, doors; *h*, space for thermostat and thermometer; *i*, supports; *j*, thermometer; *k*, thermostat.

There is a felt-lined groove (*k*) around the door, which fits over a flange on the chamber. There are two openings (*o*) into the top of the chamber, which serve as ventilators and through which thermometers may be inserted. The six small openings (*q*) into the chamber under the door, which may be closed by a copper slide, serve for ventilation and the escape of CO_2. A Roux or other slow thermostat can be inserted in the water jacket through the opening (*l*) in the top. The cock (*n*) in the bottom of the water jacket serves to draw off the water when desired. The overflow pipe serves as a drain for the water from the melting ice when the ice box is being used. The opening (*p*) through the side of the chamber is for the insertion of a self-registering thermometer. The trays (*d*) are made of nineteen strands of No. 12 brass wire bound with copper strips and are supported by ledges (*e*) on the sides of the chamber. The copper water pan rests on the bottom of the chamber, and the evaporation from it serves to keep the air in the chamber moist. The base is made of heavy galvanized sheet iron, provided with ventilators at top and bottom to supply fresh air to the lamp or gas burner, which can be inserted through the door (*s*).

SEMPERS GERMINATING CHAMBER.

This germinating chamber is modeled after one designed and used by Mr. Frank W. Sempers, of Blythedale, Md. While the temperature can not be kept as uniform in this as in the standard chamber, it gives excellent results for regular work. On account of its simple construction it can be made at a low cost by any good carpenter with the aid of a tinsmith. Fig. 11 shows working drawings of this chamber.

It is essentially a tight, wooden box, with doors on the front, ledges on the sides and in the middle to carry the trays, and an open water tank let through the bottom. This differs from other forms of germinating chambers in that the heat is applied directly underneath the water tank, which opens into the chamber. The water vapor furnishes the necessary heat and keeps the germinating seeds and substratum moist. A small space (*h*) is left between the two tiers of trays, in which a thermometer and thermostat can be inserted. The water tank (*d*) is copper, with a 1-inch flange (*f*) around the top, by which it is fastened to the bottom of the chamber. The sides of the tank extend $2\frac{1}{2}$ inches below the bottom (*e*) to partially confine the heat from the lamp or gas burner underneath. The doors shut against wide cleats all around, so that shrinking and swelling will not prevent their opening and shutting easily.

BLANK FORMS FOR RECORD AND REPORT.

The forms on pages 22–24 are used by the Seed Laboratory of the Bureau of Plant Industry of this Department. The form for records of purity tests given on page 22 occupies the front side and that for germination tests on page 23 the back of a 5 by 8 inch library card.

Record sheet—purity and germination tests.

Kind:

Received ..... 190 . Herbarium No.....

Report to .....

Sent by .....

Address.....

Where grown..... 190 .

Date of purity test ..... 190 . Grams used.....

Character of inert matter .....

Pure seed, per cent.	Inert matter, per cent.	Foreign seed, per cent.	Total impurities, per cent.

Remarks.....

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Purity test made by.....

Foreign seeds.

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Kind:

Germination test begun									
Soaked		hours.		hours.		hours.		hours.	
Temperature C.									
		Blotting paper.		Cloth.					
Seed bed		1.	2.	1.	2.	1.	2.	1.	2.
Number of seeds tested									
Number germinated each day.	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Germination test made by									
day germination.	Per cent.								
	Average per cent.								
Number hard at close of test									
Total germination.	Per cent.								
	Average per cent.								
Actual value									

Report of purity test of seed received ——— —, 190 .

Test No.	Sender's mark.	Name of seed.	Per cent of pure seed.	Per cent of inert matter.	Per cent of foreign seed.

Pure seed includes all seed of the kind being examined.
Inert matter includes broken seeds, dirt, stones, sticks, chaff, and other similar material.
Foreign seed includes all seeds except those of the kind being examined.
A germination test of the above seed is being made and will be reported later.

Remarks:

——— ———,

The name of the U. S. Department of Agriculture must not be used for advertising purposes in connection with this report.

Preliminary report of germination test of seed received ——— —, 190 .

Test No.	Sender's mark.	Name of seed.	Duration of test in days.	Germination, per cent.

A final report will be sent on completion of test.

Remarks:

——— ———,

The name of the U. S. Department of Agriculture must not be used for advertising purposes in connection with this report.

Final report of germination test of seed received ——— —, 190 .

Test No.	Sender's mark.	Name of seed.	Duration of test in days.	Germination, per cent.	Actual value, per cent.

The actual value is the percentage of pure seed that will germinate. This is obtained by multiplying the percentage of pure seed by the percentage of total germination of the pure seed.

Remarks:

——— ———,

The name of the U. S. Department of Agriculture must not be used for advertising purposes in connection with this report.

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